

Risk orientation predicts hypoxic time during difficult airway simulation: a mixed-methods pilot study

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ABSTRACT

Personality factors may explain some of the practice variation observed in medicine. In this pilot study, we used simulation to investigate the relationship between risk orientation and airway management. We hypothesised that higher risk tolerance would predict earlier intervention. Ten emergency medicine residents from the University of Alberta participated in a standardised difficult airway simulation. There was a constant rate of oxygen desaturation necessitating eventual airway intervention. A debriefing interview and a risk orientation questionnaire followed. Time of hypoxia prior to intervention was the outcome measure. Audio interview transcripts underwent thematic analysis. Nine participants were included; one did not complete the simulation as instructed. Higher risk tolerance predicted longer hypoxic time prior to intubation ($r=0.72$, $p=0.03$). Theme analysis revealed consistent fears regarding patient instability and chances of a failed airway intervention. Patient instability was emphasised more so by those who intervened earlier. We show that personality characteristics influence resuscitation decision-making at an early stage of training. Trainees may therefore be susceptible to certain types of medical error based on their risk aversion. Implications for resident training, care quality and patient safety are discussed.

INTRODUCTION

Errors in decision-making may be a common cause of preventable harm during resuscitation. They can be divided into errors of commission or omission.^{1,2} An error of omission is the failure to perform a required action, for example, the delayed intubation of a hypoxic patient. An error of commission, on the other hand, describes an undesired action, for example, premature intubation attempts in a patient with a known anatomically difficult airway.

The reasons for error-prone decision-making are likely multifactorial and it is possible that personality factors, such as risk tolerance, contribute. Supporting this notion, attending emergency physicians who are risk-averse employ more conservative management strategies in patients with low-risk chest pain.^{3,4} Conversely, risk-tolerant providers order fewer advanced imaging tests in patients with abdominal pain⁵ and head injury.⁶ Our literature review did not yield studies directly relating risk tolerance and procedural intervention, yet, one might suppose that rare and 'risky' procedures, such as endotracheal intubation or cricothyrotomy, would be avoided by the risk averse physician.

Through a nuanced description of individual characteristics as they relate to decision-making, we may better understand practice variability and medical error. The goal of this pilot study was to use simulation to explore the relationship between risk tolerance and decision-making during a simulated difficult paediatric airway scenario. We hypothesised that team leaders with higher risk tolerance would proceed to a cricothyrotomy faster than those who were more risk averse.

METHODS

Design

We conducted an observational simulation-based pilot study using a convenience sample of junior emergency medicine resident physicians in Edmonton, Alberta, Canada.

Setting and recruitment

After informed consent was obtained, residents participated in a simulation session. Debriefing interviews were conducted by the authors (unblinded) immediately following the simulations. In these interviews, the participants were probed regarding their decision-making, specifically about their perceptions of risk in the hypoxic patient. The interviews were audio recorded, transcribed and then analysed for themes. Following the simulation, each participant completed a risk tolerance questionnaire over email.

Simulation scenario

Detailed information can be found in Appendix 1 and online supplementary table 1. In brief, an adolescent (Laerdal SimMan 3G) presented in respiratory distress with pneumonia. This was a fictional case and any resemblance to a real person, living or deceased, is coincidence. Vital sign progression was controlled with oxygen saturation decreasing ($-3\%/min$) while respiratory and heart rates increased ($+3.75$ and $+1.75$ units/min, respectively). The team leader was informed that, according to medical records, an emergency surgical airway had been established during a previous elective general anaesthetic because of unexpectedly difficult anatomy. No consultants were made available during the scenario and two scripted confederate nurses assisted. Each simulation scenario was video and audio recorded.

Risk tolerance questionnaire

The literature was searched for a measure of risk tolerance specific to the medical context, but none were found. Most questionnaires have been



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developed in the social sciences and purposed for settings outside of healthcare. There was significant variability in questionnaire format, length and target constructs.⁷ Some other risk tolerance studies in healthcare have used a modified form of the Jackson Personality Inventory⁸ though there is little reliability evidence for its use.

Author consensus was used to choose the most appropriate questionnaire considering three main criteria: (1) content, (2) intuitiveness and (3) convenience of distribution. The Rohrmann Risk Orientation Questionnaire was chosen (Appendix 2).⁹ This 12-item questionnaire is reliable, felt to measure relevant risk variables and feasible to administer online.

Outcome measures

Coprimary outcome measures were: (1) time of hypoxia ($\text{SpO}_2 < 85\%$, in minutes) prior to the verbalised decision to intubate and (2) time of hypoxia prior to skin incision for a cricothyrotomy. The independent variable was risk tolerance comprised of two component scores, risk propensity and risk aversion. Pearson correlation coefficients were calculated using STATA/1C V15.1 statistical software.

A theme analysis of interview transcripts using NVivo 12 software was performed. This software helped to identify words and phrases representing common and recurrent conceptual themes which were then reviewed for validity by two of the authors. Reviewers were blinded to the participant's performance.

RESULTS

Ten PGY-2 residents participated in the study. One participant was excluded from the final analysis. The outlying participant exhausted the scenario time without any intervention and, on debrief, did not comprehend the nature of the task and was fixated on achieving a precise diagnosis.

Quantitative analysis

As expected, risk propensity and risk aversion scores were negatively correlated ($r = -0.7$, $p = 0.02$; Cronbach's $\alpha = 0.8$). We observed a statistically significant positive correlation between risk propensity and time of hypoxia prior to intubation ($r = 0.7$, $p = 0.03$; figure 1). Higher risk propensity trended towards association with longer hypoxic time prior to cricothyrotomy ($r = 0.6$, $p = 0.06$) whereas risk aversion trended towards association with shorter hypoxic time before intubation ($r = -0.4$, $p = 0.27$) and cricothyrotomy ($r = -0.4$, $p = 0.26$).

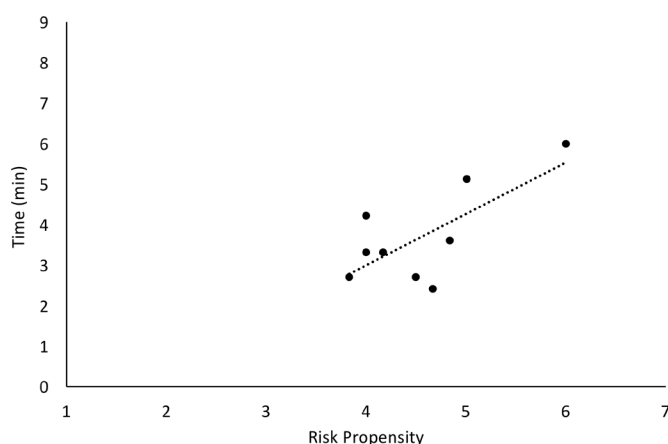


Figure 1 Hypoxic time prior to intubation vs risk propensity ($r = 0.7$, $p = 0.03$).

Table 1 Frequency of themes encountered during debriefing interviews

| Participants (in order of increasing hypoxic time) | Frequency of themes of patient instability | Frequency of themes of difficult airway |
|--|--|---|
| 1 | 9 | 5 |
| 2 | 6 | 4 |
| 3 | 6 | 2 |
| 4 | 4 | 4 |
| 5 | 6 | 3 |
| 6 | 5 | 2 |
| 7 | 4 | 4 |
| 8 | 4 | 1 |
| 9 | 2 | 2 |

Qualitative analysis

Two major themes were identified in participant interviews: (1) concerns regarding patient instability (eg, 'forced to act', 'patient is going to arrest') and (2) concerns regarding difficult airway (eg, 'even anaesthesia couldn't get it'). Participants who tolerated longer hypoxia expressed less concern about patient instability, whereas concerns regarding airway anatomy were relatively constant (table 1).

DISCUSSION

We show here that risk averse physicians more hastily intubate a known difficult airway which is counter to our original hypothesis. To our knowledge, no existing studies explore the relationship between personality and critical incident decision-making; however, prior data suggest that risk aversion may predict more conservative management strategies.^{3-5 10-16} These results, alongside our own, might be interpreted as suggestion that action (eg, testing, hospital admission, procedural intervention) alleviates the uncertainty of inaction (eg, observation) and is therefore more tolerable to the risk averse.

Practice variation was first described in 1973 by Wennberg and Gittelsohn who observed regional variations in the management of similar disease states.¹⁷ Since then, numerous examples of physician-driven practice variation have been described including varied rates of advanced imaging use,^{5 6 11 18 19} timing of antibiotic administration in sepsis,²⁰ rates of obstetrical intervention,²¹ modalities of chest pain evaluation⁴ and outcomes in ventilated patients.²² The degree to which this variation is desirable, or acceptable, is debated.²³ It seems self-evident that some variation must exist given the complexity and heterogeneity of patients; however, some authors assert that *most* of the observed variation is unwarranted.²⁴

Our experiment illustrates the power of simulation research to detect physician variation in difficult to study clinical contexts. By controlling the clinical events, physician-driven differences become more evident. The degree of variation we observed is unlikely to have resulted from changes in the simulation environment. In turn, one might therefore wonder if the observed variation in tolerated hypoxic time was acceptable, or safe. Safety thresholds in this context are unknown and difficult to determine, therefore, future studies might attempt define 'safe' and 'appropriate' according to expert consensus and/or group norms.

Importantly, our data suggest that at least some variation is explained by personality characteristics, namely, risk tolerance. Previous authors have explored similar associations with conflicting results. Sorum and colleagues found that lab testing varies with the physician's tolerance for clinical uncertainty.¹⁶ Risk tolerance and

treatment choice are also correlated in patients with acute chest pain.^{4,8} However, conflicting results have emerged in other clinical settings, for example, bronchiolitis admission rates,¹² management of simulated fetal distress cases^{13,15} and laparoscopic cholecystectomy complication rates.²⁵ Our study is the first to examine the correlation of risk aversion in the highly time-sensitive and stressful resuscitation environment.

Our methodology presents an important educational innovation. Accuracy of self-perception is linked to improved performance and learning,^{26–28} and by providing learners with objective data linking their unique personality with observable behaviours we may promote a reflective and individualised learning process. Interestingly, we observed that our participants held varied perceptions of clinical stability despite a controlled scenario. It is therefore possible that risk tolerance influences one's interpretation of clinical events and the resulting mental representation mediates the effect of personality on behaviour. Alternatively, we must also consider the possibility that participants biased their recall during postevent interviews to retrospectively justify their actions, be it consciously or subconsciously. Clarifying these cognitive phenomena may help to understand how clinical expertise is attained and why it sometimes fails us.

Limitations

This study is limited by a small sample size compounded by the exclusion of one participant raising the possibility of spurious findings. Despite this, we observed consistent trends and a statistically significant results in the remaining sample. We cannot, however, exclude the possibility that risk orientation contributed to this participant's extreme delay of intervention. It is also possible that questionnaire responses were altered to justify prior actions (cognitive dissonance).²⁹ However, we believe that the reverse sequence (questionnaire before simulation) provides no advantage because: (1) questionnaire responses could equally influence future actions and (2) experimental blinding was most complete prior to questionnaire. Finally, our results may not generalise to real-world scenarios. However, we believe that the clinical scenario was realistic and allowed for naturalistic adaptation as our participants conveyed a cognitively demanding and stressful experience.

CONCLUSION

Overall, this study represents a novel use of simulation to explore the cognitive processes that underlie critical event decision-making. We show that personality traits influence seemingly objective medical decisions and therefore may contribute to the medical errors in the real-world. Further understanding of these phenomena may help explain practice variation and spur harm reduction interventions.

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